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Occultations of Fixed Stars observed at Ashurst, near Dorking.

By Robert Snow, Esq.

Lat. 51° 15′ 58″ North ; Long. $1^{m}\ 10^{s}$ West.

5-feet Equatoreal.

Date. 1849.	Star's Name.	Immersion, Sid. Time. h m s	Limb.	Emersion, Sid. Time. h m s	Limb.
May 5*	95 Virginis	13 17 55·4	Dark		
7†	η Libræ	14 16 38·6	Bright	15 35 53·6	Dark.
Sep. 5	ν Piscium	21 29 24	Bright	22 10 23	Dark.
8‡	θ^2 Tauri	22 20 0	Bright	22 47 51	Dark.
—	80 Tauri	22 37 5	Bright		
—	81 Tauri			23 46 52	Dark.
—	85 Tauri			0 23 44	Dark.
Oct. 5	θ^2 Tauri	7 22 5·3	Bright		

* Star well seen, moon very bright, and nearly full.

† η *Libræ* emerged close to two illuminated lunar summits, which appeared to have suddenly become triple.

‡ θ^2 *Tauri* was, at immersion, first seen in *contact* with the moon's bright limb at $22^{h}\ 19^{m}\ 44^{s}$. Moon's limb very tremulous. Before the star finally disappeared, it suffered projection for $3^{s}\pm$, being then just wholly within the moon's limb.

Appearance of Saturn's Ring, &c. in the Equatoreal of Cambridge, United States. By Professor Bond.

"During the period of the disappearance of *Saturn's* ring in 1848, we often noticed breaks or inequalities in the ring, such as would arise from irregularities in its structure, were the matter of which it is composed unequally distributed in its different parts.

"Something of this kind has often before been observed, but hitherto only on the *illuminated* side of the ring. That similar appearances present themselves also on the *unilluminated* side is a new feature, important in its bearing on the true explanation of these phenomena.

"From June to September 1848 the light reflected from the edge of the ring (the only part then visible), instead of being uniformly distributed over a single line, was interrupted on each side of the planet by spaces of some seconds in breadth, where it was barely possible to trace the continuity of the edge. These inequalities were sufficiently abrupt to render it difficult to distinguish at first sight between them and the somewhat similar effects produced by either of the small satellites being projected upon the ring; their presence could only be detected by their motion, of which the indications were usually decisive in 15 or 20 minutes. On the other hand, the irregularities of the ring always retained one fixed position with reference to the ball, as long as the earth remained elevated above the *southern unilluminated* surface.

"The same appearances were again presented between September

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and January 1849, while the earth was elevated above the ***northern unilluminated*** surface, in all this time retaining one fixed position with respect to the ball.

"It is an unavoidable inference from our observations that these breaks in the illumination of the edge do not rotate about the globe of *Saturn*; a result perfectly in accordance with what Schroeter has established with regard to the corresponding irregularities on the *illuminated* side.

"The fact of these inequalities always retaining one unaltered position may be explained without precluding the possibility of a rapid rotation of the rings, by attributing them to the reflexion of the solar rays from their inner edges. There seems to be no other way of accounting for their being seen on both surfaces, both when illuminated and when turned away from the sun.

"The first reappearance of the ring took place between August $31^{d}\cdot78$, Greenwich M. T., and Sept. $3^{d}\cdot80$; the second disappearance between Sept. $12^{d}\cdot80$ and Sept. $13^{d}\cdot62$; and the final reappearance in 1849 between Jan. $18^{d}\cdot47$ and Jan. $19^{d}\cdot43$.

"On two or three occasions in the past year we have enjoyed the sight of all the eight satellites at once.

"Our observations for a year or two past on the variations of the brightness of *Jupiter's* satellites afford some curious results. Attention was first drawn to the subject in observing a transit of the third satellite on the 6th of January, 1847. A few minutes after its entrance the satellite was visible on the disc just within the limit of the planet, being brighter than the surrounding surface; soon after a dark spot, supposed to be the satellite, could just be discerned in its place. The telescope used was an achromatic of 2¾ inches aperture, of excellent quality, but not powerful enough to enable us to decide whether or not the spot was really the satellite.

"On the 28th of January, 1848, during the transit of the shadows of the first and third satellites, the third satellite itself was seen with the great refractor under very beautiful definition, as a black spot between the two shadows, and not to be distinguished from them except by the place it occupied. It was smaller than its shadow in the proportion of 3 to 5, not duskish simply, but quite black like the shadows. On the 11th of March it was again seen dark on the disc, smaller than its shadow.

"On the 18th of March we watched the entire transit. At the first internal contact the satellite was distinctly seen on the disc, *brighter* than *Jupiter*, though it had entered on a bright channel south of one of the great equatoreal belts; 20 minutes after it had become nearly of the same brightness with the planet, so as to be barely perceptible, yet still whiter than the surrounding surface. While watching it with close attention, a minute dark speck suddenly made its appearance in the place of the satellite, increasing very rapidly till it occupied a space of about one second of arc in diameter, quite black and nearly round, though an irregularity of shape was suspected. Remaining thus for about two hours, the darkness gradually lost its intensity, and quite disappeared before

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the satellite left the disc. Something of this nature we have always observed to accompany a transit of this satellite. The first and fourth satellites we have also seen black or dusky on the disc, but the former has once or twice crossed without our detecting any change. The spots are always less than the shadows, but have appreciable diameters, and make their appearance after the entrance of the satellite upon the limb of *Jupiter*. Changes of relative brightness are constantly going on; the feeblest, on the average, being the fourth, and the brightest usually the third.

"It would be well, as soon as *Jupiter* reaches a convenient position, say during the ensuing winter and in the spring of 1850, for observers generally to record their estimates of the relative brightness of the satellites as often as possible. The labour of doing this will be but trifling, and may lead to the discovery of the laws of these singular phenomena.

"We have observed Schweitzer's comet twice since its reappearance.

"From the circles of the great equatoreal compared with B. A. C. No. 1634, we have:—

	Cambridge M. T.	Comet's R.A. 1849·0.	Comet's Decl. 1849·0.
1849.	h m s	h m s	° ′ ″
Aug. 24	15 37 30	4 45 0·4	−27 14 14
26	15 38 42	4 41 5·4	−27 17 45

"With the micrometer we have the following places:—

	Cambridge M.T.				
1849.	h m s		m s		′ ″
Aug. 24	15 37 30	Comet follows ∗ in	0 34·75	Comet N. of ∗ by	7 36·5
26	15 38 42	precedes ∗ by	3 20·35	N. of ∗ by	4 5·7

∗ is Lacaille 1613, whose place seems to be erroneous in N. P. D.

"The star Lalande 9167, of the 7·8 magnitude, is missing."

The Astronomer Royal exhibited an instrument for performing arithmetical multiplications and divisions, constructed under the direction of William Bell, Esq., Coronation Road, Bristol. The President remarked, that for mere exhibition of the significant figures produced by a single multiplication or division, to a certain degree of accuracy, nothing could be more convenient than the common sliding rule containing two similar scales, one fixed and the other moveable, in which the lengths corresponding to the numbers represented are the logarithms of those numbers corresponding to a certain modulus. In the scales of this kind in common use at the Royal Observatory, the distance from 1 to 10 upon the scale is about 12 inches; and with these dimensions, a product or quotient will be accurate, with the roughest degree of attention, to $\frac{1}{300}$ part; an accuracy which suffices for a vast amount of the small calculations in an observatory. And with proper scales for trigonometrical functions, the problems of plane and spherical trigonometry can in most cases be easily solved. These inconveniences, however,

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attend it: 1st. It cannot be conveniently applied to multiply three or more quantities, or in general to exhibit a product of even two which is given in a different denomination; as when a sine is given by the product of two tangents: this failure, however, may usually be remedied by the use of two parallel sliders. 2dly. When used to multiply numbers, it gives no information as to the place of the decimal point in the product. It is to remove some of these inconveniences, but especially the last, that Mr. Bell has constructed his instrument.

The logarithmic spaces in Mr. Bell's machine are arranged upon a circle, a single series of numbers from 1 to 10 occupying the entire circumference. This construction, as is well known, may be used in the same way as the common sliding rule; but, like it, it gives no information as to the decimal point. But the revolving circle is connected by toothed wheel-work with two smaller circles, each of which performs one revolution for ten revolutions of the principal circle, and each of which has upon its circumference ten series of logarithmic numbers. These small circles, then, give us the means of defining the decimal place, in multiplicand, in multiplier, and in product. Thus, the successive figures 1 upon one circumference may stand for ·00001, ·0001, ·001, ·01, ·1, 1, 10, 100, 1000, 10000. The rotating index of each circle is adjustable; there are also adjustable indices on the fixed frame. Suppose, then, we had to multiply 27·42 by 332·6, we should, both in the principal circle and in one of the smaller circles, set the 1 of the moveable circle or index to 27·42 on the fixed circle; but there would be this difference, that on the principal circle we have no respect to the decimal point, whereas on the smaller circle we should set to the 2742 following the 10. Then for 332·6 we should turn the principal circle from 1 to 3326, but we should also turn it two complete revolutions, which would carry the index of the second small circle from 1 to the 3326 following 100. Then the figures of the product will be exhibited very accurately on the principal circle, and much less accurately on the first of the small circles, but they would be found in that series of numbers which follows 1000, and the place of the decimal point would thus be exactly defined.

For the multiplication of three or more numbers, it is necessary to plant moveable indices after performing the first products; this process, however, is much less convenient than that with two sliding scales in the sliding rule.

The Astronomer Royal remarked, that in his opinion this construction is too expensive and too cumbrous to be extensively used. But he wished much to call the attention of members of the Society to the use of the sliding rule, and to the peculiar defect which he had indicated; and to represent to them the great value of any simple construction which, while preserving the other advantages of the sliding rule, would effectually remove that defect.

Mr. Drach suggests that a calculating machine, exhibited by Mr. F. Schiereck in 1837 (the construction of which was concealed by the inventor, who wanted 700*l.* for his secret), might probably

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be a particular modification of the sliding rule applied to a circular form. He also suggests the addition of other concentric circles to Mr. Bell's scale, in which the trigonometric or other logarithmic numbers might be laid down.

The Astronomer Royal gave an oral statement of the progress made by Lord Rosse in the mounting of his 6-feet speculum.

In a lecture delivered on this subject by the Astronomer Royal in November 1848, a detailed account was given of the distortions produced in the speculum by using the telescope at different inclinations to the horizon, and of the explanation of these distortions suggested by Lord Rosse, and also of the nature of the remedial measures tried by Lord Rosse while the Astronomer Royal was at Parsonstown. It will be sufficient to recall here, that when the edge of the speculum rested against short iron pillars fixed in the breechpiece of the telescope, the firm hold produced by friction of the edge of the speculum on the pillars, combined with the varying elasticity of the triangular lever-supports in different inclinations of the telescope, produced distortion of the mirror; and that when, to avoid this friction, the mirror was suspended (as regarded its edge-bearing), either by a semicircular hoop or by a chain, a small difference in the edgewise pressure, depending on a difference of inclination of the telescope, threw some of the points of the supporting levers out of bearing, and distortion of the mirror was produced. This latter fault arose from the circumstance that the mirror could not slip freely over the points of the supporting levers. To remedy this, the following arrangement is now made. Each of the plates resting on the 27 supporting points, instead of being partially attached to the mirror by a layer of felt and pitch, is completely separated from it, to the distance of about $1\frac{1}{4}$ inch, and the speculum rests upon each plate by 3 turned brass balls at the three angles of the plate; so that the whole surface of the speculum is now supported by 81 brass balls. Each of these balls has a fine wire, passing through a small hole in the plate, and kept in tension by a weak spring on the opposite side; this prevents the ball from rolling away when the mirror is detached, but allows entire freedom of motion to the ball, to the extent of about 1 inch in any direction. Lord Rosse has reason to think that this construction is perfectly successful for its object. He has already found that the speculum may be moved laterally half an inch without the smallest discoverable distortion. Before the balls were used, when the speculum was moved laterally $\frac{1}{30}$ of an inch, vision was destroyed.

Lord Rosse thinks it, however, desirable to arrange the edgewise support, so that as little as possible may be trusted to the motion of the balls. The lower semicircle of the edge is now to be grasped by a strong iron hoop, very neatly fitted to it; and the upper semicircle is to have a thin hoop furnished with a drawing-screw or contracting screw, merely for the purpose of bringing the strong hoop constantly into fair contact with the edge of the mirror. And the ends of the strong hoop (which are at the extremity of a hori-

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zontal diameter of the mirror) are to be supported by rods, attached to a horizontal bar which rests on the two upper pillars of the breech-piece, with the utmost freedom of motion; so that the mirror will be supported edgewise by jimbals of the most perfect construction. Lord Rosse hopes that, with this arrangement, in combination with the support on the balls already described, the mounting of the mirror will be sensibly perfect.

Lord Rosse had also communicated to the Astronomer Royal some remarks upon the process of grinding large mirrors. With mirrors of 3 feet aperture there is not the smallest difficulty. In the mirrors ground and polished by his apparatus, there is no appreciable difference of focal length of the central part and the annulus next the edge; and this result is obtained uniformly. Still, with the 6-feet mirrors there is great difficulty. In all cases, a figure is obtained which will do well for work; rarely is one obtained which is perfectly satisfactory. This arises in part from the impossibility of testing the mirror while it is under the machine.

Adverting to Mr. Lassell's use of a wooden polisher, Lord Rosse had stated to the Astronomer Royal, that he himself had at first used a wooden polisher, but that he had abandoned it, as there appeared to be abundant evidence that the polisher was continually changing its figure from the absorption of moisture. He considers it totally inadmissible for very large specula. It will, however, probably be necessary, with Mr. Lassell's apparatus, to use a light wooden polisher, because it appears scarcely practicable in that apparatus to apply a counterpoise.

In speaking of the results of observations with the large telescope, Lord Rosse had stated to the Astronomer Royal that the nebula H. 131 exhibited a well-marked spiral structure, and that 2241 has a central hollow.

In the *Monthly Notices*, vol. ix. p. 214, line 34, Mr. Hartnup has thrown out a suggestion that the indifferent rate of chronometers, W. Shepherd, 222 & 230 (fitted with Mr. Hartnup's new balance), might be due to mal-position during trial (the maker had left pins at the bottom projecting below the base rim).

Since the publication of that number, the Editor of the *Monthly Notices* has, by the favour of the Astronomer Royal, been permitted to inspect the arrangements of the chronometer-room at Greenwich, and to see the various contrivances adopted there to give every chronometer a proper *assiette*, whatever the form of the base may be. The Editor is now convinced that Mr. Hartnup's hypothesis is not tenable, and he takes some blame to himself for not inquiring into the matter before publication.*

The heliometer by the Brothers Repsold, of Hamburg, has been erected at the Radcliffe Observatory, and is now undergoing

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* Chronometer-makers, who send their timekeepers to Greenwich for trial, should give them as wide a base as the case will allow, and take previous care to make them rest soundly on the base rim when placed on a flat surface. This would save trouble, and prevent possible misapprehension.

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the careful scrutiny of Mr. Johnson. Upon so very delicate and complicated an instrument, no *positive* opinion can well be formed until the observer has thoroughly mastered its manipulation, and ascertained the degree of consistency of its results. Mr. Johnson has already found that it can be directed and read off with facility, (the illumination of the scale at the object glass is successfully obtained by a wire heated by powerful magnets,) and that the images of all stars, except the brightest, are round and free from wings when seen through the halved glasses. An instrument of such optical perfection can scarcely fail, in the hands of so delicate and scrupulous an observer as Mr. Johnson, to prove a most powerful engine in carrying on a large and very important class of investigations which have hitherto not been sufficiently attended to in this country, for want of means.

W. S. Jacob, Esq., F.R.A.S., and late Captain in the Bombay Engineers, has been appointed to the Observatory at Madras by the Hon. Court of Directors. As an amateur observer, Capt. Jacob's zeal and talents have been already amply shewn in the publications of this Society. He has now a wide field for distinguishing himself and his patrons, the East India Company.

Professor Wackerbarth states, on Mr. J. M. Kemble's authority (Saxons in England), that the Saxon yard was about one-tenth longer than the modern yard, or that 100 Saxon yards = 110 English yards. The value of the Saxon yard is so nearly identical with the metre, 1·0936 yards, that the Professor is inclined to suggest the possibility of the Saxon yard being actually derived from a former measure of the earth, made at a period beyond the range of history, the results of which have been preserved during many centuries of barbarism.

Some Remarks on Falling Stars by Mr. Lowe.*

Mr. Lowe gives the following epochs when falling stars are said to be abundant :—

April 22^d to 25^d	Nov. 12^d to 14^d
July 17 .. 26	Nov. 27 .. 29
Aug. 9 .. 11	Dec. 6 .. 12

To which he adds from his own observation, Oct. 16^d to 18^d. There are many occurrences in January, but the days do not appear to be fixed.

Mr. Lowe then states by whom observations have been made at the foregoing epochs, and when and where.

The August epoch has been observed every year since 1841, and is said by Mr. Lowe to be the most certain.

The November epoch, 12^d to 14^d, seems also well fixed, but has in late years been surpassed by the August epoch in brilliancy.

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* Further particulars will be found in the forthcoming Report of the British Association, "Catalogue of Observations on Luminous Meteors," by Professor Powell; and "Some Remarks on Luminous Meteors," by E. J. Lowe, Esq.